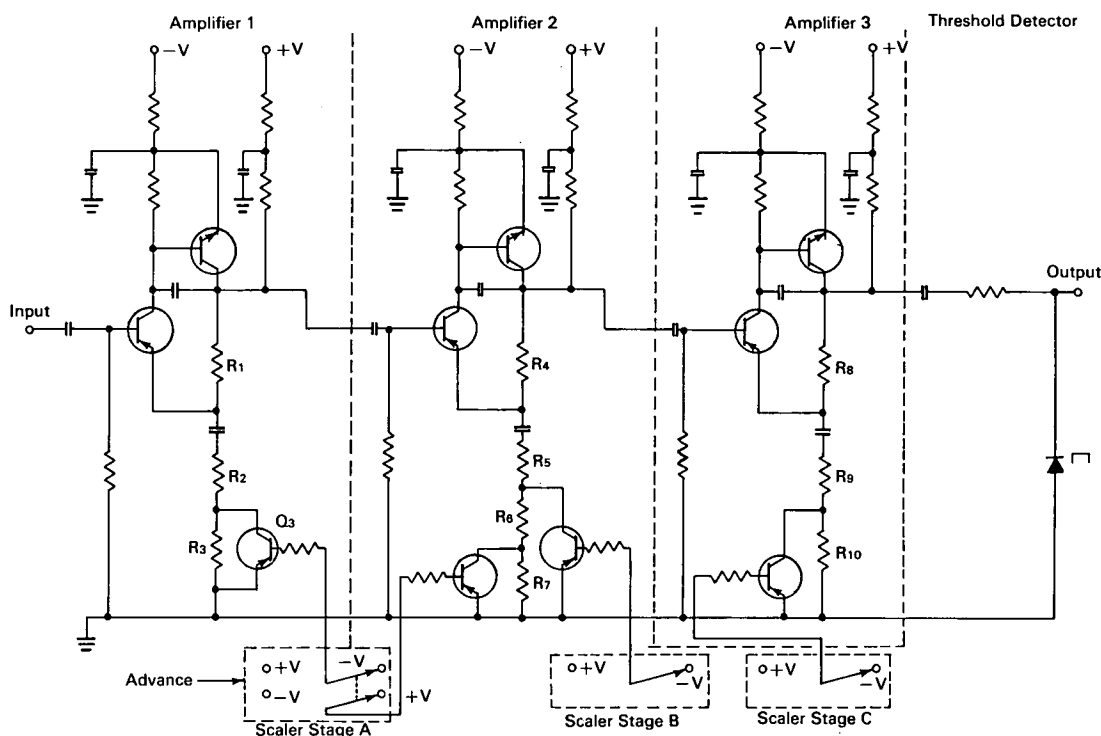


NASA TECH BRIEF



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Digitally Controlled Pulse-Level Discriminator Operates Over Wide Voltage Range



The problem:

Designing a low power-drain discriminator circuit that will generate an output pulse when an input pulse exceeds a discrete digitally controlled threshold voltage. The discriminator must operate over a wide linear or nonlinear range of threshold levels. Conventional discriminators employ unduly complex circuitry to convert the digital settings to threshold-voltage references and compare them with the input

pulses. These discriminators are limited to a narrow linear range and operate at relatively low efficiency.

The solution:

A discriminator employing several amplifier stages ahead of a fixed-reference threshold detector consisting of a tunnel diode in series with a resistor. Binary scaler stages are used to control the overall amplifier gains corresponding to discrete input signal threshold levels. The discriminator can be designed to operate

(continued overleaf)

over a wide linear or nonlinear range by direct digital control.

How it's done:

An eight-level discriminator that operates over a wide range of threshold voltages is shown in the circuit diagram. Amplifiers 1, 2, and 3 are similar transistor feedback amplifiers. Appropriate selection of the feedback resistors R_1 through R_{10} permits each amplifier to operate at one of two or three discrete gains. One of these gains can be set by the scaler stages connected to the respective amplifier. The overall gain of the three amplifiers, which is the product of the individual amplifier gains, can thus have eight discrete values corresponding to the eight possible combinations of states of the three scaler stages. The minimum input (threshold) signal required to trigger the threshold detector (and thereby yield an output pulse) can therefore be set at eight discrete levels by the scaler stages. For example, if the scalars select an overall amplifier gain of 48, a 30-millivolt (minimum) input pulse will trigger the threshold detector (1.44 volt fixed threshold); whereas for an overall gain of 24, a 60-millivolt input pulse is required for triggering.

The basis of selecting the feedback resistors can be understood with reference to the operation of amplifier 1. Transistor Q_3 , shunting resistor R_3 , is biased on or off depending on the state of Scaler stage A. With Q_3 biased off, the amplifier gain is $(R_1 + R_2 + R_3)/$

$(R_2 + R_3)$. With Q_3 biased on, the effective value of R_3 is 0, and the gain is $(R_1 + R_2)/R_2$. Appropriate selection of the individual resistances yields the two discrete gains required of Amplifier 1. Similarly, appropriate selection of R_4 , R_5 , R_6 , R_7 , and of R_8 , R_9 , R_{10} yield the discrete gains required of Amplifiers 2 and 3, respectively.

Notes:

1. The number of threshold levels can be changed by changing the number of amplifier and scaler stages. The maximum number of levels is limited by the dynamic range and gain accuracy of the amplifiers.
2. By appropriate selection of the amplifier gains and scaler controls, the discriminator will operate over various linear and/or nonlinear (e.g., logarithmic) ranges.
3. Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Greenbelt, Maryland, 20771
Reference: B66-10129

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C., 20546.

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(GSFC-324)